Interim Progress Report Submitted in February 2005 to NOAA
Human Dimensions of Global Change Research (HDGCR) Program

Project Title

Decision Support System for Agricultural Applications of Climate Forecast in West Africa

Investigators
University of Florida

Shrikant Jagtap (Principle Investigators), Ag & Bio Eng., Uni. of Florida
Jim Jones, Ag & Bio Eng., Uni. Of Florida
Ken Boote, Agronomy Department, Uni. Of Florida

Ghanian Research Team
Samuel G.K. Adiku (Soil-Crop-Climate Modeler) Dept. Soil Science, Uni. of Ghana, Legon
J. B. Naab (Agronomist and Soil Scientist), SARI, Wa Office, Wa
D. S. Dzorgbo (Social Scientist) Dept. of Sociology, University of Ghana, Legon
Andy Nkansah (Agro-meteorologist) Meteorological Services Department, Accra

NOAA Grant No. NA04OAR4310081

Project Period: Three years (June 2004 – May 2007)

I. Preliminary Materials

A. Project Abstract

The message conveyed by West African Farmers to date is that the long-lead climate forecasts although are potentially valuable, their potential is currently under-utilized due to failure of support services (i.e. meteorological services, ministry of agriculture, financial institutions and extension agencies) to provide the necessary downscaled forecast and the appropriate forecast-dependent logistic support (inputs, credit facilities, and advice) to the benefit of the farmers. It appears that the support services sector is unaware of the advances in climate science involving ENSO teleconnections and do not seem to understand although very much appreciates the implications and possibilities associated with this new information. Peanut is not only a major high-protein and major vegetable oil food in the Ghanaian (**See Map 1**) diet, but it is also a cash crop and the cake remaining after oil extraction offers high quality feed for animals. Because local and international markets exist for peanuts, they provide an essential opportunity for small-scale subsistence farmers, many of whom are women (**See photo 1**), to generate income and improve living standards for themselves and their families. This research project is developing climate-forecast-based decision support systems that will enable support services to routinely evaluate risks and opportunities for crop production in Ghana using climate forecasts. We are exploring with a family of crop models, how various responses to ENSO events might affect crop production. In the second purpose, our goal is to assess the potential added value of providing more information to support services and farmers than is currently available through climate forecasting. This will be achieved by coupling climate forecast information with further model analyses to provide a better context for decision makers and producers, and then ask if this more elaborate information gives them any more flexibility and decision options than the climate data alone. In the third phase, we will design and test the decision aids that would be needed by support services so they can provide logistical support to farmers. We intend to use this project to have a wide-ranging operational impact on activities of support services as well as productivity and profitability of agricultural commodities in general and peanuts in particular through improved understanding and use of climate forecasts. Improved climate and weather information will lead to more informed management decisions and reduced risks for yield losses.

B. Objective of Research Project

This research project will assess the factors- both scientific and societal – affecting the use of long-lead climate forecast by government, banks, and extension services (referred to as support services hereafter) and to develop information for use by farmers for making informed decisions. We have four specific objectives to be achieved over a three-year duration: (1) Document knowledge of climate variability and its impact on peanut production among the major stakeholders in the agricultural sector in Ghana and determine how these stakeholders use (do not use) the knowledge to plan their operations, (2) Develop a climate diagnosis system for downscaling climate forecasts at different locations and for various times of the year and disseminate them along with a package of recommendations for managing crop production though existing mechanisms and institutions., (3) Develop decision aids to forecast the impact of climate variability on peanut production and to inform all stakeholders of those risks and management options that reduce them, and (4) Evaluate the use of decision aids within in each institution and how it impacts policy decisions they make and ultimately how it benefits peanut farmers.

C. Approach by objective

1. Using a participatory interactive process we will synthesize how the effects of climate variability are perceived and how climate forecasts and products are used (or not used) by stakeholders in support services sector as well as farmers. Through this objective we intend to address an important goal of the

HDGCR program by focusing on several essential but weak institutions that empower societies' use of climate forecasts in developing countries.

2. Highly erratic rainfall and low water holding capacity soils are major features of Ghanaian production systems. Therefore any advice needs to be site specific. To achieve this we will collect a comprehensive historical daily weather data in pilot study regions. Weather data at each location will be categorized by October-December ENSO phase. Then statistical methods will be used to determine the underlying probability distributions of monthly rainfall and temperatures associated with each ENSO phase at each location. In doing so, we will endeavor to present climate information as a starting point in discussing climate variability and climate forecasts, which can be used by stakeholders to assess risks. We will model the daily weather data using a locally adapted weather generator conditioned on ENSO phases for input into a peanut crop model. Repeatedly using the generated daily weather series, consistent with a given climate forecast, and a peanut crop model, we will obtain frequency distributions of yields under forecast climate scenarios. This forecast-specific frequency distribution combined with each alternate peanut management decision will create a probability distribution to facilitate risk assessment and further decision-making.

3. Studies in the USA, Australia, and some parts of Africa have reported that seasonal climate forecasting offers potential for improving management of crop production risks. The situation in W. Africa is unique; it appears that farmers there are most likely to benefit if seasonal climate (i.e. rainfall) forecasts are distributed as an integral part of an extension package that includes discussion of the nature of the forecast, potential response strategies, and risk management options. A range of tools and concepts have been developed to deal with the need to reduce economic loss in dry years, while taking advantage of good seasons by adjusting inputs, management, or crops. These include response farming in which the crop is managed in accordance with the rainfall prediction based on the date of onset of the rains and actual amount received in the early part of the season. Other tools include crop simulation models linked with models of daily rainfall accounting for El Niño effects. We will pursue several participative systems approaches involving simulation-aided discussions with support services and decision makers for understanding and analyzing decision processes as they relate to use of climate forecasts to assist farmers in Ghana.

4. *Evaluating the use of decision aids within in each institution* will enable us to identify and resolve problems to operationally use the prototypes decision aids to be developed. We will work with all stakeholders to evaluate the utility of the systems and to obtain feedback to improve it. We will also identify what adjustments in the climate forecast tools/products can be made to maximize the probability that stakeholders will take action and correctly use the products. Support services personnel from each of the three Agroecological zones (Humid, Savanna, and Semi-arid) will be invited to participate in training program given jointly by both the UF and Ghanaian teams.

D. Description of any matching funds used for this project.

The project is paying 50% of the salary support for PI. All other co-operators are being paid by their host institutions. We estimate that additional matching support from UF amounts to $20,000/year and that from the four Ghanaian collaborators about $ 50,000/year.

II. Interactions

A. We have made initial contacts with agricultural development banks, marketing organizations; farm input providers, extension services, water management boards, and number if farming communities in southern Ghana around Akatsi, in coastal savanna zone and at WA located in the Upper West Region of Ghana. A preliminary questionnaire was prepared and has been distributed to stakeholders. Group meetings are scheduled for February 23-25 at Akatsi and March 1-3 in Wa to discuss results of interviews and information on applications of climate forecast. During this workshop, group discussions will be held to systematically determine from each stakeholders point of view (policy maker, banks, extension, farmers) information on climate sensitive decision calendar, the nature and timings of the prediction required for each decision, and the availability of decision options with their estimation of costs, benefits, and penalty in the event of a wrong decisions. Findings from this meeting will be published in a report.

B. The PI has held informal discussion with IRI and Florida State University to access outputs from their global and regional (FSU only) models. A proposal was submitted to START (Systems for Research Analysis and Training) fellowship, so that a Nigerian visiting scholar will spend three months at the University of Florida to work with the PI and exploring various downscaling approaches. The PI is in routine contact with the African Desk at NOAA and is exploring possibilities for using NOAA's regionally estimated precipitation in crop simulation models. Our team has also made contacts with other regional networks in Africa, so we can extend this methodology to other important crops in the region. Currently two proposals are pending with the START to extend this methodology into Nigeria. Our team will participate in PRESAO 2005, whenever it is held in W. Africa.

C. The PI is also part of the team of SE Climate Consortium – RISA and keeps close watch on which research methodology can be exchanged between the US and African continents.

III. Accomplishments

Research tasks accomplished – Inaugural meeting between the PI and Ghanaian researchers took place in Accra Ghana from November 16-20, 2004 and was followed by field visits to Wa from November 21-27, 2004. Major goal of this meeting was to revisit the objective, activities, and prepare first year work plans to achieve these milestones. The meeting resulted with a list of potential stakeholders to be considered for participation in this project. Following this meeting, a team led by Dr. S. Adiku, visited stakeholders in Akatsi (**See photo 2**) to inform and sensitize stakeholders about this project and seeks their collaboration. Akatsi District is a small place. Most stakeholders live within maximum 5 to 10 km from Akatsi town. In attendance were:

1. Francis Seglah (Ministry of Agriculture Staff)
2. Kamith Aheto (Ministry of Agriculture Staff)
3. Robert Gademor (Ministry of Agriculture Staff)
4. Emmanuel Atika (Ministry of Agriculture Staff)
5. Lovelace Bankas (Project Officer, Akatsi Rural Bank)
6. Akandi Agbodzi (Veterinary Section)
7. Togbui Ahotor (Chief) Water and Sanitation Board Chairman
8. Agasor Victor (Akatsi District Assembly)
9. Dodzi Simon (Best Akatsi Farmer 2003)
10. Aligo Winfred (Meteorological Services Dept. Akatsi)
11. Lumor Robert (District Chief Agricultural Officer)

The meeting focused on 3 main questions: 1. what is the awareness level of each participant in climate variability 2. To what extent does climate variability a factor in participant's decision making and 3. How would a forecast climate help improve your planning. Participants gave varying answers to these questions. For example, the Rural Bank Officer observed that about 90% of failure to repay loans by farmers is attributed to poor season and crop failure. Yet, seasonal forecast of climate considerations are not among the criteria currently used to assess application for credit by farmers. The veterinary officer noted that climate variability is an important factor in animal production not only by affecting availability of good pasture but also drinking water availability for animals is affected. In poor seasons, animals may roam over 30 km in search of water. Further, epidemics of certain diseases are associated with some types of weather. Climate forecast would there fore be very important for the animal production industry. The water and sanitation group would require climate forecast to make decisions on bore whole construction. The Meteorological Office has accumulated climate data over many years but have no mandate to analyze the data for decision making. This is a major handicap.

Since that meeting, a total of 15 farmers have been pre-interviewed by extension staff, and our team will meet with 5 of these farmers for the Sondeo. Similarly, a total of 10 marketers have been pre-interviewed by Extension staff. All other stakeholders were distributed questionnaires.

A similar activity was undertaken by Dr. J. Naab in WA, where he met with the following stakeholders individually to find out if they would be interested in climate forecast and they expressed their interest in participating. They were:

1. Agricultural Development Bank (ADB)
2. Sonzelle, Nandom and Tumu Rural Banks
3.Ministry of Food and Agriculture (MOFA) - all the 5 districts
4. Nandom Agric. Project (NAP)
5. Plan Ghana (an NGO)
6. TECHNOSERVE (an NGO)
7. Upper West Agro-Enterprise (an NGO)
8. Meteorological Services - Wa
9. Selected farmers in the region.

The project has received strong letters of support from several organizations including farmer groups who are keen to experiment with new climate forecasting technologies.

B. Research findings There is enormous interest among all stake-holders in working with the project team. We are currently processing information gathered so far.

C. Papers. Jagtap, S. S. and J. B. Naab, 2005. Farmer Compatible Crop-Season Rainfall Forecasting Technique for Crop Management Decisions in West Africa, submitted to Climate Research

D. Deviation due to late arrival of funds – Although NOAA funds arrived on time, UF had installed a new accounting system that delayed release of funds till mid September. As a result we lost 2004 cropping season which normally begins in June.

IV. IV. Relevance to the field of human-environment interactions

A. Describe how the results of your project are furthering the field of understanding and analyzing the use of climate information in decision-making

The project is just starting, so we do not have any concrete information to report.

B. Where appropriate, describe how this research builds on any previously funded HDGEC research (i.e., through NSF, EPA, NASA, DOE, NGOs, etc.)

Our project was partially based on finding of following reports and publications. Some of these activities were supported by NOAA.

Adiku, S.G.K and Stone, R.C. 1995. Using the southern oscillation index for improving rainfall prediction and agricultural water management in Ghana. *Agric. Water Management*, 29: 85-100.

Adiku, S.G.K., P.W.A Dayananda, C.W. Rose and G.N.N. Dowuona. 1997. An analysis of the Within-season rainfall characteristics and simulation of the daily rainfall in two savanna zones of Ghana. *Agricultural and Forest Meteor.*, 86: 51-62.

Bonsu, M. 1998. A study of vulnerability of cereal production to climate change and adaptation strategies in Ghana. Report EPA, Accra, Ghana

Hulme, M., 1992. Rainfall changes in Africa: 1931-1960 to 1961-1990. International Journal of Climatology 12: 685-699.

Jagtap, S.S., J. W. Jones, P. Hildebrand, J. J. O'Brien, G. Podestá, D. Letson, F. Zazueta. 2002. Responding to Stakeholders Demand for Climate Information: From Research to Practical Applications in Florida,

Jones, J. W., J. W. Hansen, F. S. Royce and C. D. Messina. 2000. Potential benefits of climate forecasting to agriculture. Agr. Ecosytems & Env. 82:169-184.

Kirshen, P. H. and I. Flitrcroft. 2000. Use of seasonal precipitation forecasting to improve agricultural production in the Sudano-Sahel: and institutional analysis of Burkina Faso. Natural Resources Forum 24:185-195.

Naab, J. B., P. Singh, K. J. Boote, J. W. Jones, and K. O. Marfo. 2003. Evaluation of CROPGRO-peanut model for quantifying yield gaps of groundnut in the Guinean Savanna zone of Ghana. Agronomy J. (submitted, in review).

Roncoli, M.C., K. T. Ingram and P. H. Kirshen. 2000. Can farmers of Burkina Faso use rainfall forecast? Practicing Anthropology 22:24-28.

Roncoli, M.C., K. T. Ingram and P. H. Kirshen. 2001. The cost and risks of coping: drought and diversified likelihoods in Burkina Faso. Climate Research 19:119-132.

Stewart, J. I. And W.A. Faught. 1984. Response farming of maize and beans at Katumani, Machakos District Kenya: recommendations, yield expectations, and economic benefits. East Africa Agric. For. J. 44:29-56.

Stone, R. C., G. L. Hammer, T. Marcussen. 1996. Prediction of global rainfall probabilities using phases of the Southern Oscillation Index. Nature 384:252-255.

C. How is your project explicitly contributing to the following areas of Study?

1. Adaptation to long-term climate change

2. Natural hazards mitigation
3. Institutional dimensions of global change
4. Economic value of climate forecasts
5. Developing tools for decision makers and end-users
6. Sustainability of vulnerable areas and/or people
7. Matching new scientific information with local/indigenous knowledge
8. The role of public policy in the use of climate information
9. Socioeconomic impacts of decadal climate variability
10. Other (e.g., gender issues, ways of communicating uncertain information)

The project is just starting, so we do not have any concrete information to report.

V. Graphics

1. Map of Ghana showing project sites

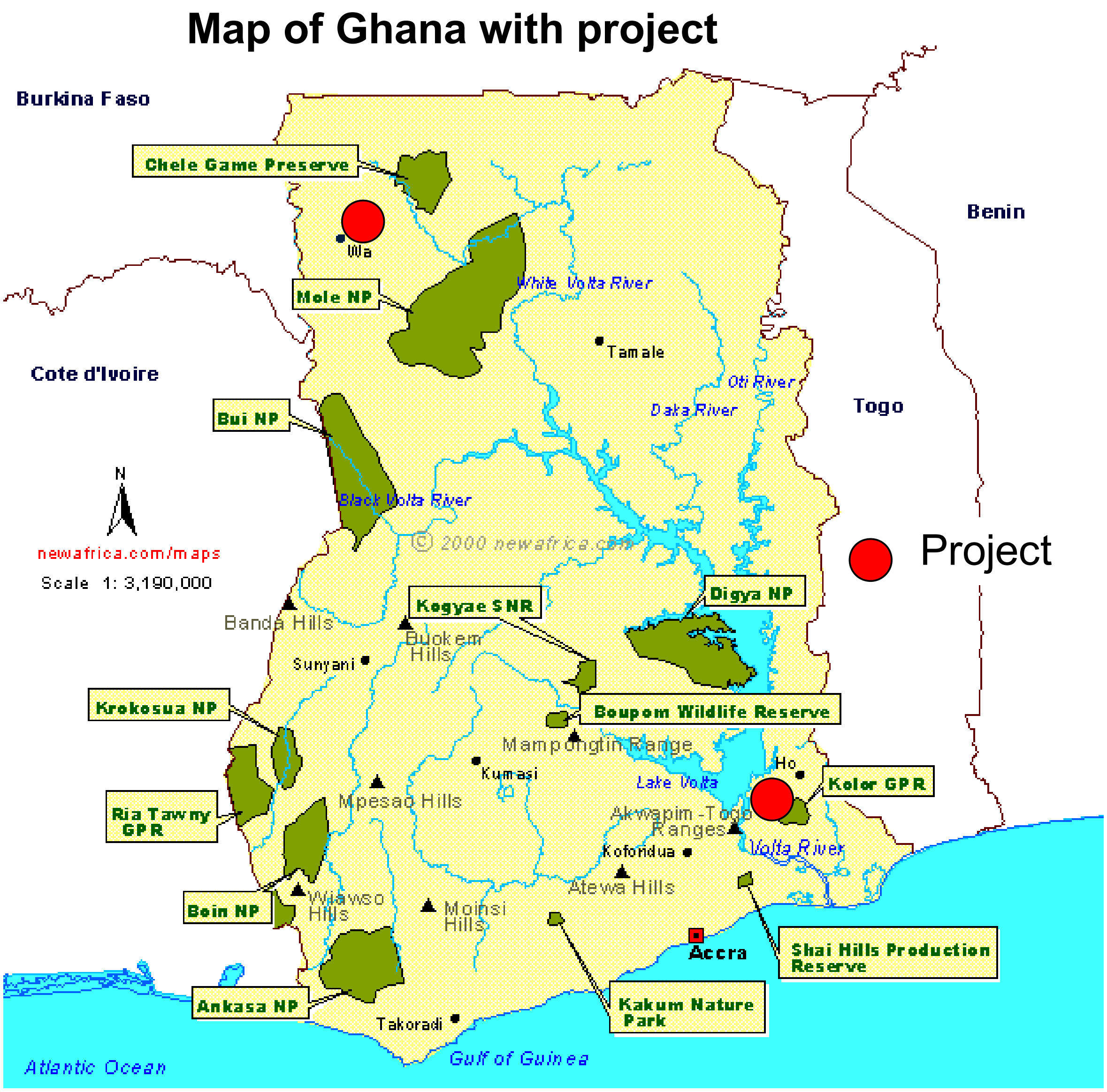

Photo 1. Groundnut is women’s crop in Ghana

Photo 2. Stakeholders in Akatsi district of Ghana voice their opinions on climate variability